IS 4519 (1977): Dimensions for copper commutator bars [MTD 8: Copper and Copper Alloys]

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Indian Standard

DIMENSIONS FOR COPPER COMMUTATOR BARS

(First Revision)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

DIMENSIONS FOR COPPER COMMUTATOR BARS

(First Revision)

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Indian Standard
DIMENSIONS FOR COPPER COMMUTATOR BARS
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 24 June 1977, after the draft finalized by the Copper and Copper Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1968. With the publication of IS : 5885-1977*, which covers requirements relating to copper and silver-bearing copper for commutator bars except dimensions and tolerances, need was felt to revise this standard and limit its scope to cover only dimensions and tolerances for commutator bars.

0.3 This standard contains a number of clauses in which the purchaser is allowed to exercise an option or which call for agreement between the purchaser and the supplier. The relevant clauses are **2.1.1**, **2.1.2**, **2.2**, **2.3.2**, **2.4.1**, **2.5.3** and **2.6.1**.

1. SCOPE

1.1 This standard specifies dimensions for copper commutator bars over 6 mm in width and up to and including 18 mm thick in which the inclination of the two surfaces is constant throughout the width (*see* Fig. 1).

1.1.1 The bars may be in random lengths, in exact specified multiples of lengths for subsequent cutting, or as plain or shaped segments of specified lengths for assembly. The surface at the thick or thin edge may be radiused or flat.

1.1.2 This standard also includes tables of preferred widths for commutator bars and details of methods of checking dimensions (*see* Appendix A).

2. DIMENSIONAL TOLERANCES

2.0 General — Bars shall be supplied to the ordered dimensions subject to the following tolerances.

*Specification for copper commutator bar (*first revision*).

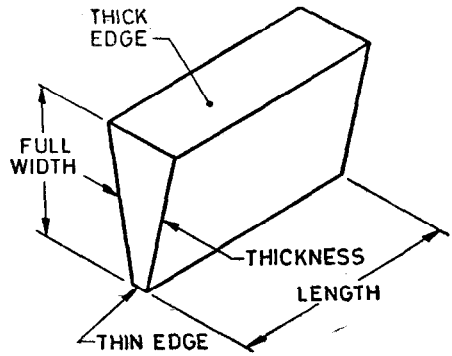


FIG. 1 COMMUTATOR BAR

2.1 Length — For bars ordered in lengths which are multiples of the segment length, the length when measured at any position across the width of the bar shall not depart from that specified by more than the amounts given in Table 1.

TABLE 1 LENGTH TOLERANCE

SPECIFIED LENGTH		TOLERANCE
Over	Up to and Including	
m	m	mm
—	2·5	+ 6·4
2·5	6·0	+12·7
6·0	—	As agreed to between the parties

2.1.1 When ordering, the purchaser shall include the necessary additional length for subsequent sawing or cutting allowance.

NOTE — The length may be determined according to following equation which is given only for guidance:

$$L = (n \times l) + n \times 3 = n(l + 3)$$

where

L = length of bar to be ordered in mm,

n = number of segments to be cut from one length, and

l = length of each segment in mm.

2.1.2 For bars ordered as segments for assembly (*see* Fig. 2) the length when measured at any position across the width of the bar shall not deviate from the specified length by more than ±0·8 mm.

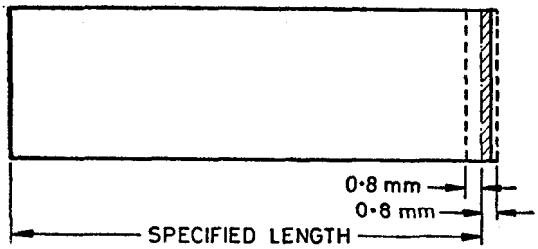


FIG. 2 SPECIFIED LENGTH

2.2 Width — The widths ordered shall, as far as possible, be chosen from the preferred widths shown in Table 2. The width shall not depart from that specified (*see* Fig. 3) by more than the amounts given in Table 3. Any tolerances other than those specified in Table 3 may be mutually agreed to between the purchaser and the supplier.

TABLE 2 PREFERRED WIDTHS (mm)

6·00	11·8	23·6	47·5	95·0
6·30	12·5	25·0	50·0	100
6·70	13·2	26·5	53·0	106
7·10	14·0	28·0	56·0	112
7·50	15·0	30·0	60·0	118
8·00	16·0	31·5	63·0	125
8·50	17·0	33·5	67·0	132
9·00	18·0	35·5	71·0	140
9·50	19·0	37·5	75·0	150
10·0	20·0	40·0	80·0	
10·6	21·2	42·5	85·0	
11·2	22·4	45·0	90·0	

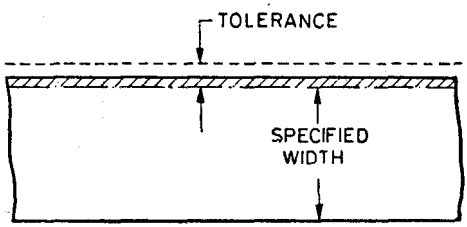


FIG. 3 SPECIFIED WIDTH

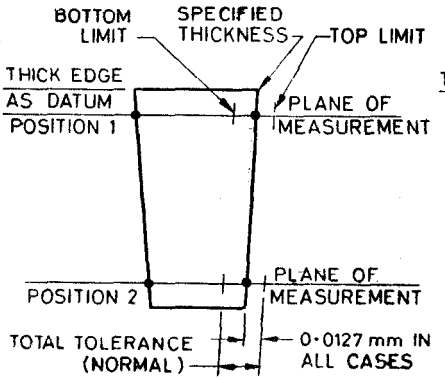
TABLE 3 WIDTH TOLERANCE

(*Clause* 2.2)

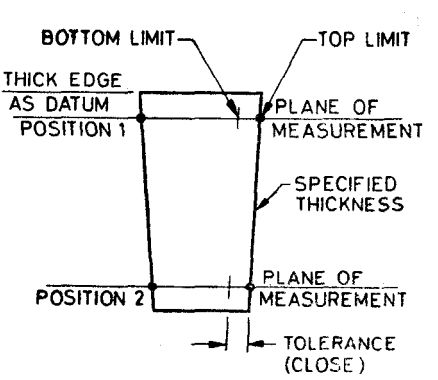
Specified Width		Tolerance
Over	Up to and Including	
mm	mm	mm
—	100	+0·20
100	—	+0·30

2.3 Thickness — The thickness shall be specified at the distance from the thick edge designated Positions 1 and 2 (*see* Fig. 4A and 4B) in Table 4.

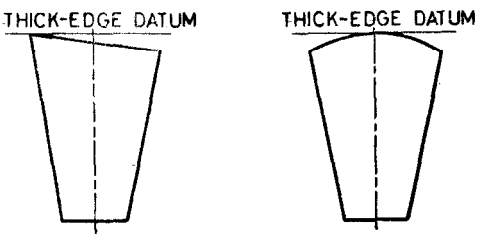
2.3.1 When measured, bars to normal tolerances shall not exceed the specified thickness by more than 0·013 mm and shall be not less than the specified thickness by more than an amount such that the total tolerance band would exceed the appropriate amount specified in Table 5 (*see* Fig. 4A).



4A



4B



4C

The thick edge datum passes at all times through the highest point on that edge irrespective of errors in its form (see Fig. 4C)

FIG. 4 SPECIFIED THICKNESS

TABLE 4 THICKNESS

(*Clause* 2.3)

Specified Width		Distance from the Thick Edge	
Over	Up to and Including	Position 1	Position 2
mm	mm		
6	25	One-eighth of specified width	Seven-eighth of specified width
25	50	3 mm	Specified width — 3 mm
50	—	6 mm	Specified width — 6 mm

2.3.2 Bars to close tolerances shall not exceed the specified thickness and shall be not less than the specified thickness by more than the appropriate amount shown in Table 5 (*see* Fig. 4B).

2.3.3 The thick-edge datum shall pass at all times through the highest point on that edge irrespective of errors in its form (*see* Fig. 4C).

2.4 Angle — The angle shall be specified by specifying the thickness at Positions 1 and 2 as in **2.3**. The departure of angle from the specified angle is measured as the difference between the deviation from the specified thickness at Position 1 and the deviation from the specified thickness at Position 2 (*see* Fig. 5).

2.4.1 The angle shall not exceed the specified angle and shall not be less than that angle by more than the amounts shown in Table 6.

2.5 Convexity and Concavity

2.5.0 Convexity or concavity at any cross section is defined as the deviation of the side face at any point from a straight line drawn across that cross section passing through the points at which the side face meets the thin and thick edges.

2.5.1 For bars up to and including 125 mm for which the width to thickness ratio at Position 2 is less than 40, this deviation shall not exceed 0·025 mm on either face measured individually (indicated as a and b in Fig. 6), and if convexity is regarded as a positive deviation and concavity as negative deviation, the algebraic sum ($a + b$) of the maximum deviation on the two faces shall not exceed $\pm$0·025 mm.

2.5.2 For bars up to and including 125 mm for which the width to thickness ratio at Position 2 is over 40, the maximum convexity or concavity on either face (a and b) shall not exceed 0·076 mm and the algebraic sum ($a + b$) of the maximum deviation on the two faces shall not exceed $\pm$0·025 mm.

TABLE 5 TOLERANCE FOR BARS

(*Clause* 2.3.2)

Specified Width		Number of Segments		Total Tolerance	
Over	Up to and Including	Over	Up to and Including	Normal	Close
mm	mm				
6	25	—	—	1 percent of the specified thickness excepting that in no case shall it be:	Position 1
				Less than 0·038 mm nor more than 0·064 mm	Less than 0·0178 nor more than 0·030 mm
25	125	—	200	1 percent of the specified Position 1 thickness excepting that in no case shall it be less than 0·051 mm nor more than 0·076 mm	—
25	125	200	—	1 percent of the specified Position 1 thickness excepting that in no case shall it be less than 0·038 mm nor more than 0·064 mm	—
125	—	—	—	As agreed to between the concerned parties	—

TABLE 6 ANGLE TOLERANCE

Specified Width		Tolerance
Over	Up to and Including	
mm	mm	mm
6	20	−0·017 8
20	40	−0·025
40	125	−0·038
125	—	As agreed to between the concerned parties

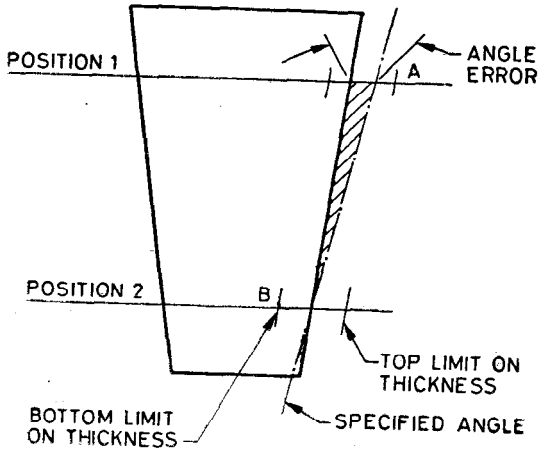


FIG. 5 ANGLE DEPARTURE

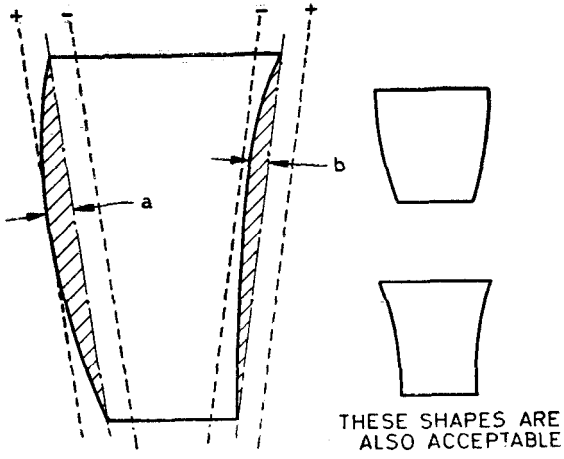


FIG. 6 CONVEXITY AND CONCAVITY

2.5.3 For bars over 125 mm in width the tolerances shall be agreed to between the supplier and the purchaser.

2.6 Squareness of Ends — For bars up to and including 125 mm wide ordered as segments for assembly, the ends shall be square to a straight line passing through the two ends of either the thick or the thin edge to within 0·006 mm/mm of width (*see* Fig. 7).

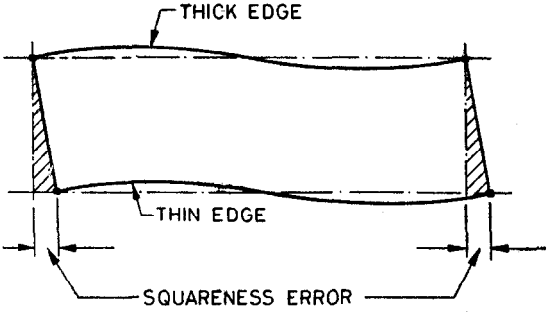


FIG. 7 SQUARENESS OF ENDS

2.6.1 For bars wider than 125 mm the tolerance shall be agreed to between the supplier and the purchaser.

2.7 Edge Bow — For bars ordered at segments for assembly, edge bow (defined as the deviation of a central line on the edge surface at any point along its length from a straight line passing through its two ends) shall not exceed ±0·000 75 mm/mm of bar length (*see* Fig. 8).

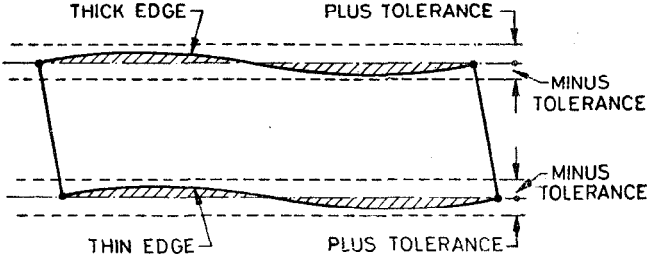


FIG. 8 EDGE BOW

2.7.1 For bars ordered as long lengths, edge bow defined as in **2.7** shall not exceed **6.4** mm in any length of 1 850 mm.

2.7.2 Measurement may be made on either edge.

2.8 Side-Face Bow — For bars ordered as segments for assembly side-face bow [defined as the deviation of the side-face at any point on a central lengthwise line (for shaped segments, *see* Fig. 10) from a straight line passing through its ends] shall not exceed 0·001 mm/mm length of bar (indicated as *a* and *b* on Fig. 9) nor shall the sum of the maximum deviation on either side of this line ($a + b$) exceed 0·001 mm/mm of length with a maximum of 0·38 mm.

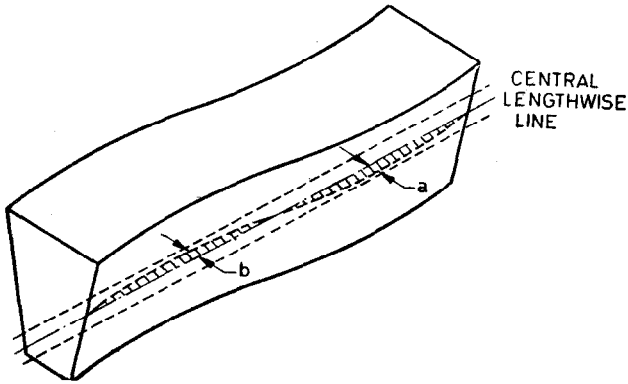


FIG. 9 SIDE-FACE BOW

2.8.1 Measurement may be made on either face.

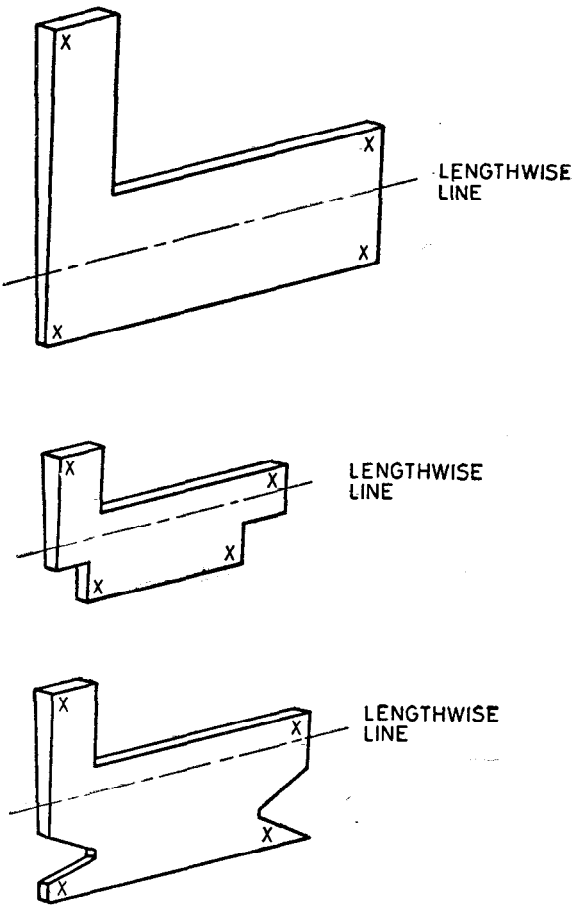
2.9 Twist of the Side Face — For bars ordered as segments for assembly, twist of the side face is defined as the deviation of one corner of the face from a plane passing through the other three corners (*see* Fig. 11 for shaped segments, corners to be used as indicated on Fig. 10).

2.9.1 For bars for which the width to thickness ratio at Position 2 is 40 or less, this deviation shall not exceed 0·005 mm/mm of length plus width of the bar. For such bars for which the length plus width is less than 100 mm, the deviation shall not exceed 0·05 mm.

2.9.2 For bars for which the width to thickness ratio at Position 2 is over 40, this deviation shall not exceed 0·001 mm/mm of length plus width. For such bars for which the length plus width is less than 100 mm the deviation shall not exceed 0·102 mm.

2.9.3 Measurement may be made on either face.

2.10 Sharpness of Corners — Unless otherwise specified, any loss of sharpness at the corners shall not exceed 10 percent of the bar thickness at Position 1, the minimum and the maximum values being 0·25 and 0·76 mm (*see* Fig. 12).



X CORNERS FOR MEASUREMENT OF TWIST

FIG. 10 SHAPED SEGMENTS

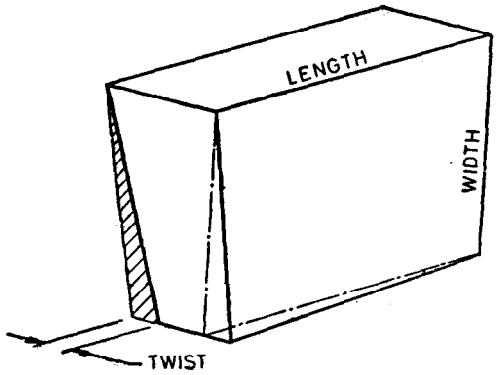


FIG. 11 TWIST OF THE SIDE FACE

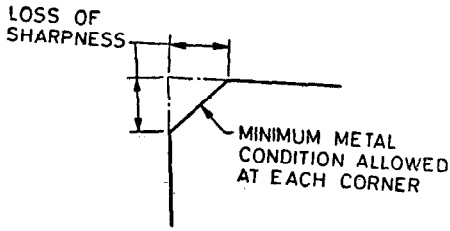


FIG. 12 SHARPNESS OF CORNERS

APPENDIX A

(Clause 1.1.2)

METHODS OF CHECKING DIMENSIONS OF COMMUTATOR BARS

A-0. This appendix has been included as a guide to those concerned with checking commutator bars on segments for dimensional conformity to this standard. No attempt has been made to provide detailed descriptions of apparatus, the aim has been to suggest the basic principles which could be followed with advantage.

A-1. THICKNESS AND ANGLE

A-1.1 Measuring Techniques — Two methods are illustrated. In the first (Fig. 13) the distance between two anvils (a fixed anvil and the non-rotating anvil of a micrometer head) is calibrated using a flat-ended length

standard. The commutator bar (or segment) is then placed in position, measurements being made in the two planes specified by adjusting the height of the packing blocks on which the bar is seated. Provision should be made to keep the bar section vertical during measurement. The form of anvil tips should be such that there is no significant indentation of the bar surface under the measuring force used; however, the radius in the plane of the cross section should be kept small unless allowance is to be made for the effect of movement of the point of contact between anvil and bar away from the anvil centre-line. A possible solution would be to use a hatchet-shaped tip as in Fig. 14.

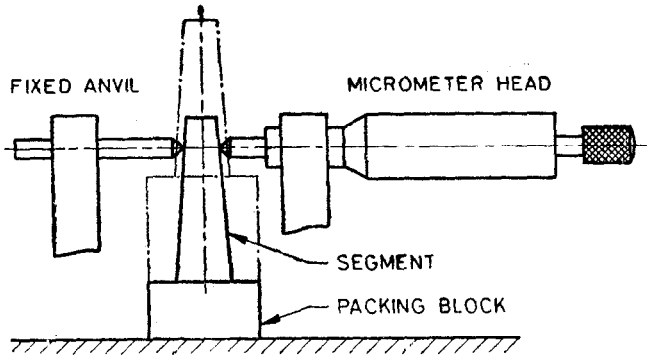


FIG. 13 MEASURING TECHNIQUE (METHOD 1)

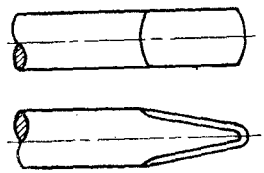


FIG. 14 VIEW OF TIP

A-1.1.1 In the second method, two measuring heads are mounted on a pivoted arm (Fig. 15), the angular position of which is controlled either by micrometer or by precision packing blocks. Both fixed and moving anvils lie approximately in the required planes of measurement. In principle, the apparatus is calibrated by use of a parallel setting piece of appropriate thickness, the measuring heads being adjusted to give a zero reading when the arm is horizontal. The arm is then raised through the specified angle, the bar on segment introduced, and the thickness error at the two planes of measurement noted. With certain forms of measuring head a direct indication of the differential reading (which is the error in angle) may be obtained.

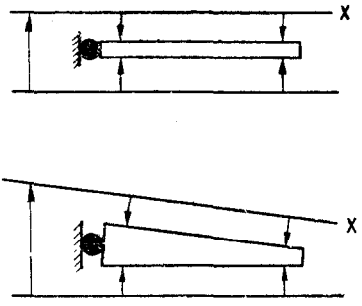


FIG. 15 MEASURING TECHNIQUE (METHOD 2)

A-1.2 Gauging Techniques — Limited use may be made of Vee-gauges for checking that the thickness in the vicinity of the specified planes is within tolerance. They could take the form illustrated in Fig. 16, one serving to check at Position 1 and the other at Position 2. It is considered that gauges cannot be satisfactorily used to check bar angle having regard to the size and nature of the tolerances on this dimensional feature.

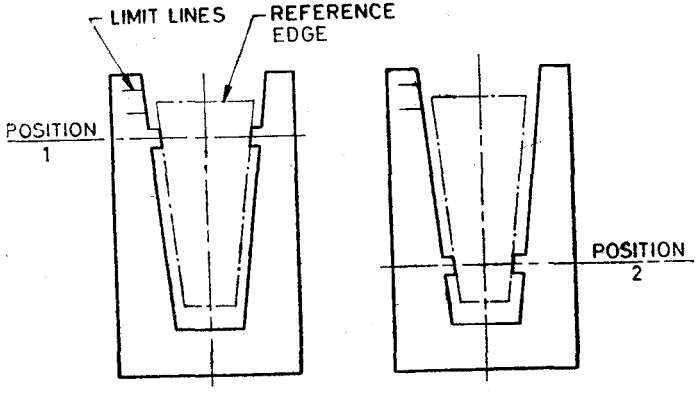


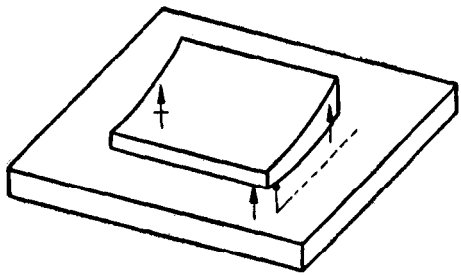
FIG. 16 GAUGING TECHNIQUE

A-2. CONVEXITY, CONCAVITY, EDGE BOW, SIDE-FACE BOW

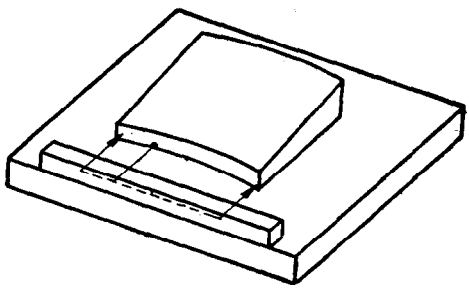
A-2.1 These errors of form may be measured, using a method in which the shape of the appropriate generator of the surface is determined by reference to an accurately flat surface lying nominally parallel to it.

A-2.2 In Fig. 17A, 17B and 17C, small arrows (↑) indicate localized supports or spacers of equal thickness, in some cases with a steadying support (↕).

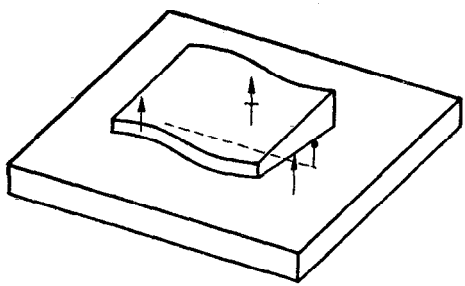
The symbol (⤒) indicates a gap-measuring device, and the dotted line the path that it has to follow when making the measurement. By setting the device to zero when positioned at one end of this path, any variation in reading as it moves along the path will be a direct indication of error present in the measured generator.



17A Convexity/Concavity



17B Edge Bow



17C Side-Face Bow

FIG. 17 ERRORS OF FORM

A-2.3 This device may be designed to record the error continuously or, in certain instances, to perform as a GO and NOT-GO gauge; for example, by operating coloured lights when the surface falls outside the tolerance band.

NOTE — In order that the full length of the generator may be examined it will be necessary for the supports to be offset from the generator. It may then be necessary to make one of the supports adjustable for height so that the gap-measuring device may be brought to a zero reading at both ends of its path; in the case of edge, how the spacers can be removed after lightly clamping the bar to the surface plate and prior to carrying out the measurement.

A-2.4 Twist may also be measured by reference to an accurately flat surface (Fig. 18), the segment being supported at three corners by blocks of equal height. A gap measuring device is then introduced at the fourth corner. As before, it may be made to operate as a GO and NOT-GO gauge, or to measure the actual error present.

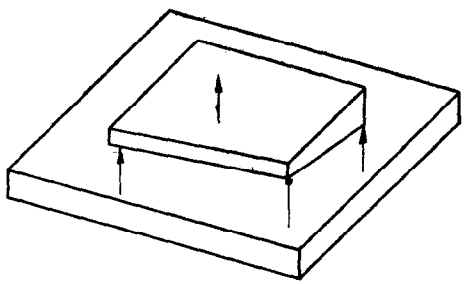


FIG. 18 TWIST

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Conversion*
Force	newton	N	1 N = 1 kg.1 m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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